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RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE LA DÉFENSE

# A simulation based system approach for bioterrorism risk assessment and evaluation of countermeasures efficiency

DGA

DÉLÉGATION GÉNÉRALE POUR L'ARMEMENT

# The French plans against terrorism

***Several inter-linked processes for security and crisis management***

**VIGIPIRATE planning :**
**To decide a warning/alert level associated with a governmental prevention posture**

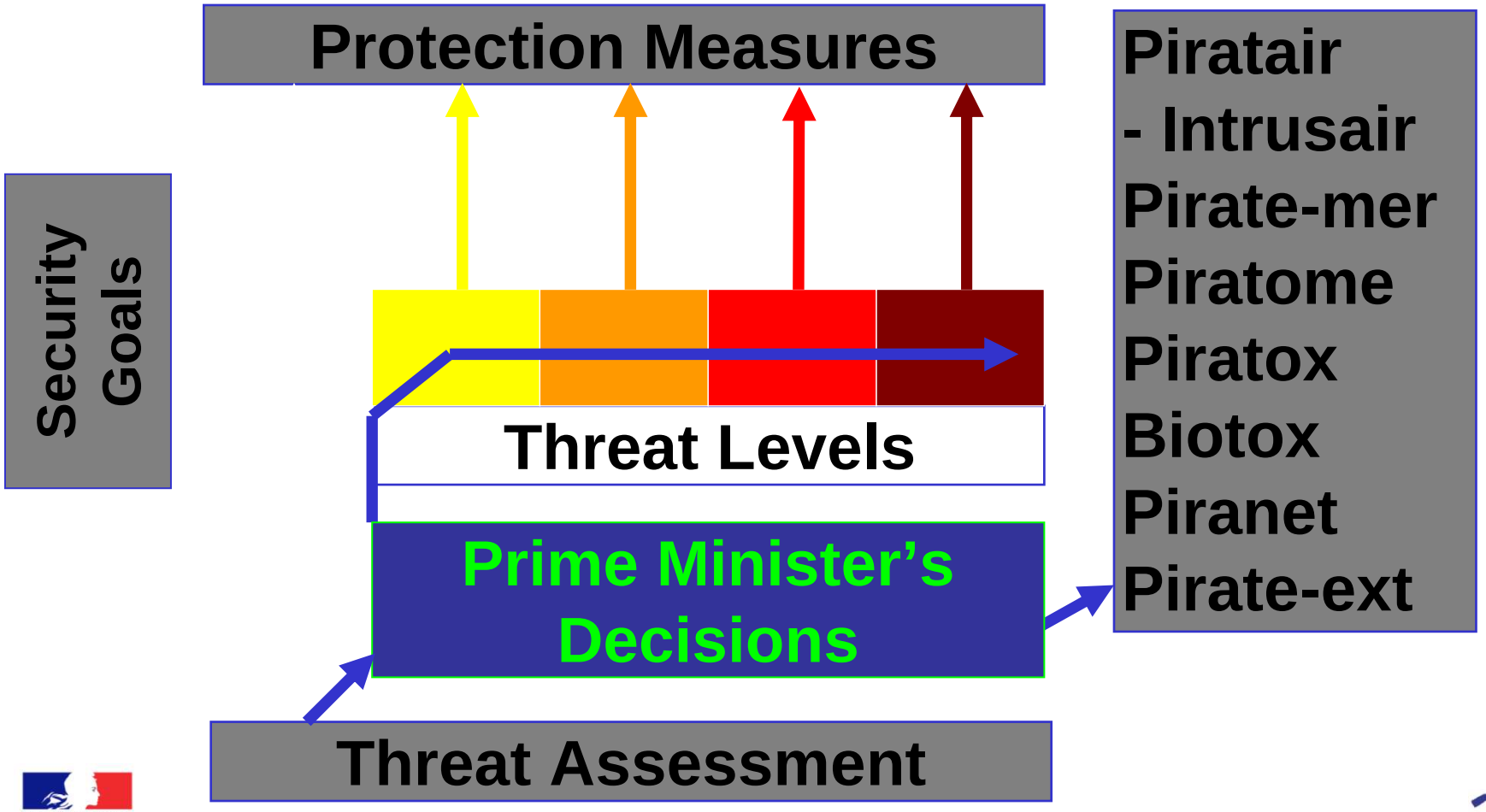
**Critical infrastructures Protection :**
**Based on a risk analysis, sets the operators posture in application of VIGIPIRATE**

**Pirate Plans :**
**intervention plans (detection, protection, mitigation) mainly in reaction**

# Vigipirate architecture

**Vigilance and Protection :**

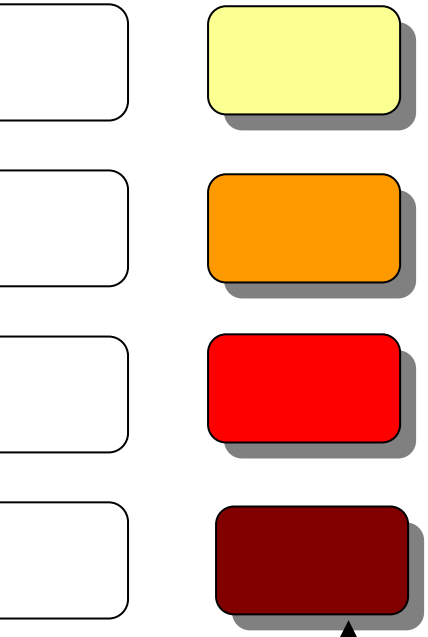
**Intervention :**



# Vigipirate architecture

## Assessing Threat…

1. No threat indication
2. Imprecise threat
3. Plausible threat
4. Highly probable threat
5. Certain threat



… leads to warning levels …

# Vigipirate architecture

## … to which security goals are associated….

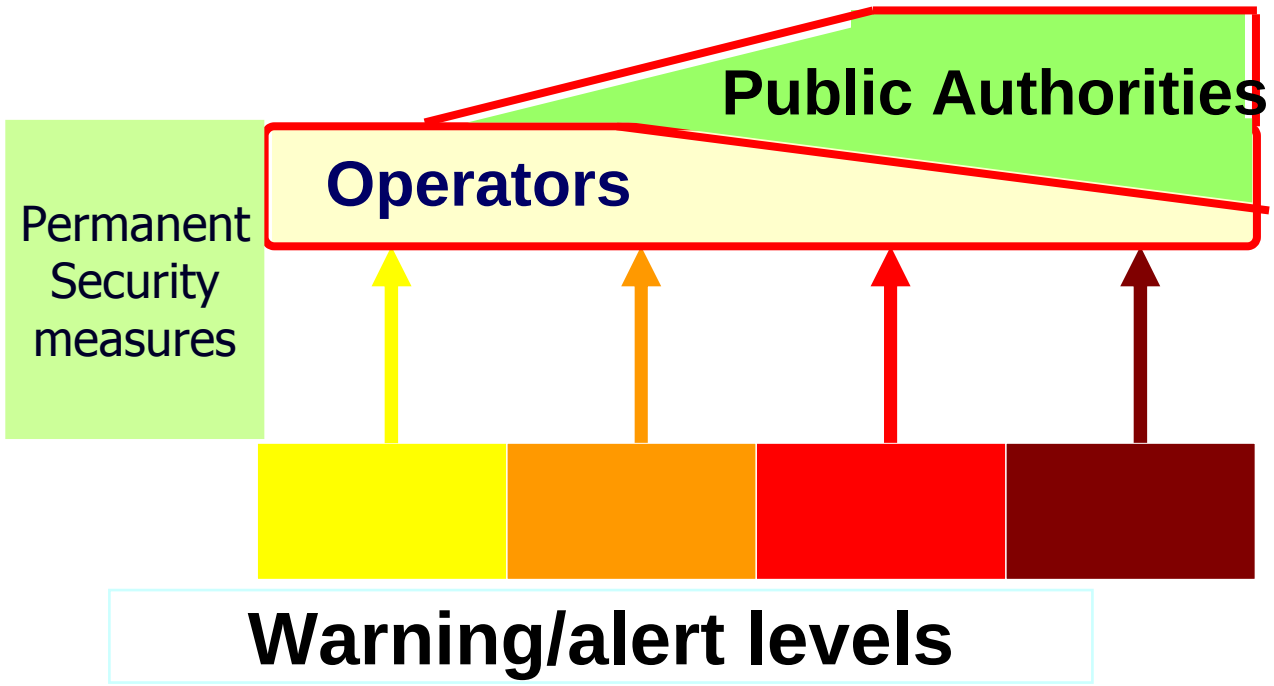
| | |
|---|---|
| Raising awareness (local measures)<br>With minimum perturbations in normal activity | |
| Preventing a risk of a plausible terrorist action,<br>At the cost of low constraints for normal activity | |
| Preventing an established risk of serious attack(s), by putting in place the needed means, with constraints on national activity | |
| Preventing a risk of major attacks, simultaneous or not, with possibly very restricting measures | |

## … then sector specific protection measures are decided.

# Vigipirate architecture

**From security goals to security measures**

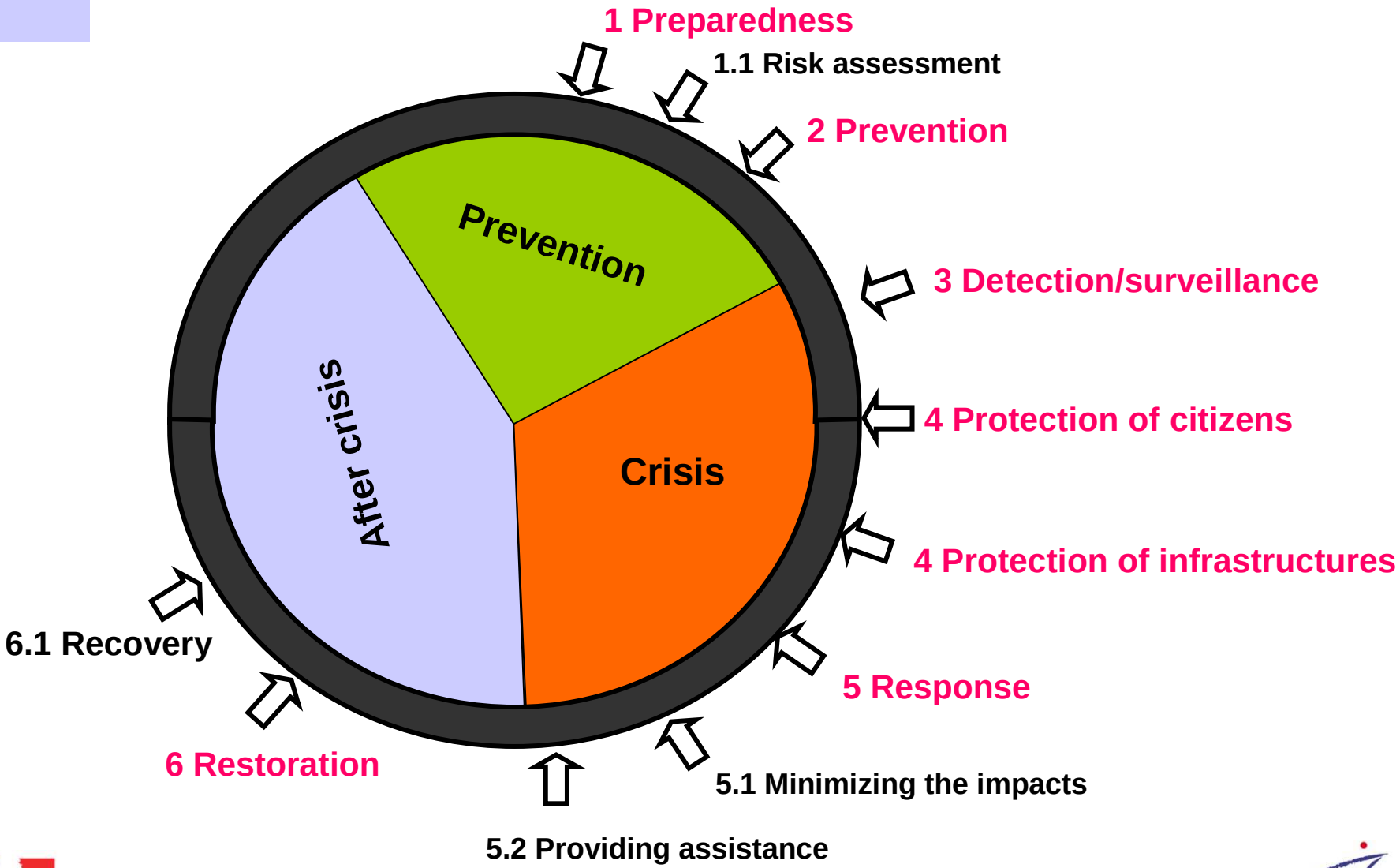
- Modular and graduated measures
- Empowerment of actors
- Shared responsibility for security



# CBRN security&safety 6 main objectives

- Preparedness : to prepare and organize ministries and stakeholders to take into account CBRN threats & risks
- Prevention : to prevent CBRN terrorism events and reduce vulnerabilities
- Detection/surveillance : to detect threats and hazards
- Protection : to reduce the vulnerability and protect citizens and infrastructures
- Response : to manage and minimize the consequences of a terrorist attack, by improving capabilities to deal with the aftermath, the coordination of the response and the needs of the victims
- Restoration/recovery : process of restoring infrastructure, of decontaminating and caring of people

# Security integrated approach …



# …supported by a coordinated R&D effort

- Coordination of ministries and follow-up of research and procurement programs
  - CBRN Strategic steering committee led by SGDN with all ministries involved
  - Main contributing Ministries:
    - Defense
    - Health
    - Home office
    - Economy
    - Prime ministry (SGDN)
- R&T programs funded by Defense
    - Defense R&T oriented program led by DGA
    - Civilian R&T oriented program steered by SGDN and led by CEA and DGA

# How to evaluate the plans efficiency ?

- “So far, so good” may not be sufficient.
- Can we challenge these plans, or part of them ?
  - Real experimentation is … challenging.
  - Training: tabletop exercises more feasible
  - Challenge through simulation seems conceptually more satisfactory.
- What need to be simulated?
  - The targeted asset and its missions within its environment
  - Aggression scenarios
  - Effects on the ability of the asset to fulfill its mission
  - Capacity of the protection system/process to mitigate the aggression effects
  - Impact of the protection system/process in absence of any aggression.

# Examples of simulated systems

- ASPIC: French project for the protection of a critical asset against a terrorist aggression;
- TWOBIAS: EC project for the protection of a critical asset against a bioterrorism aggression;
- BIOEDEP: EDA project for a biodefense system.
- Future global CBRN defense system: French MoD project that aims at developing a fully integrated CBRN defense system.

ASPIC

Aide par la Simulation à la Protection d'Infrastructure Critique

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AÉROPORT NICE CÔTE D'AZUR

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- The aims are to:
  - simulate an aggression on a critical asset (airport terminal, metro station, etc) and evaluate its consequences;
  - use simulation to design a protection system involving detection and countermeasures, and evaluate its efficiency.

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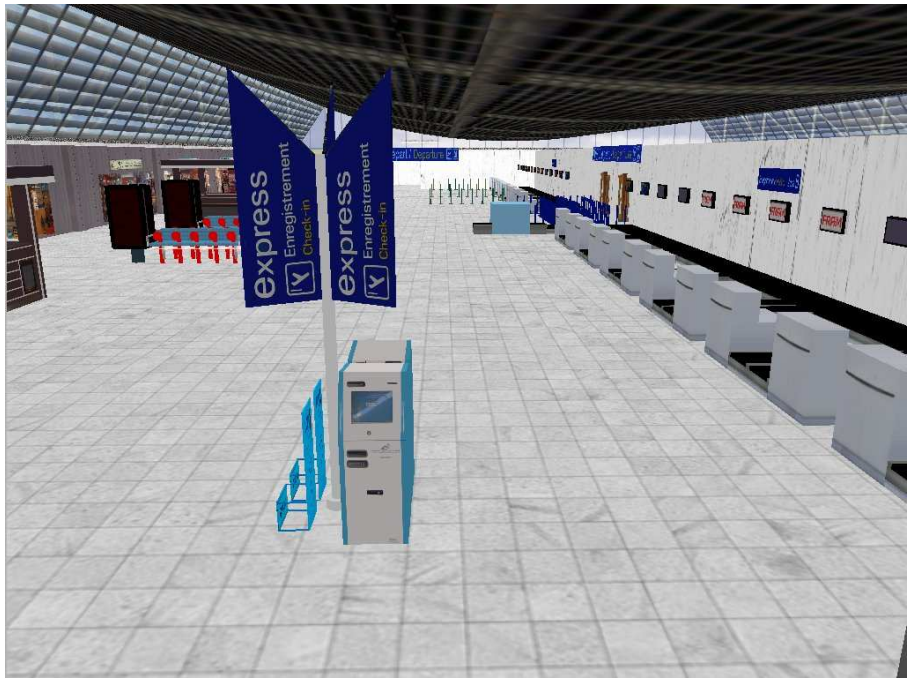
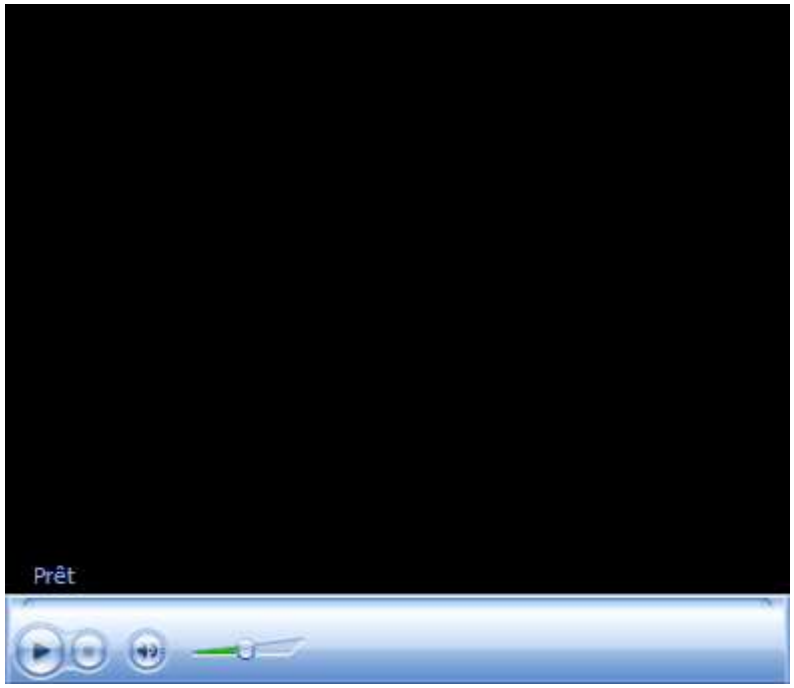
ASPIC

Aide par la Simulation à la Protection d'Infrastructure Critique

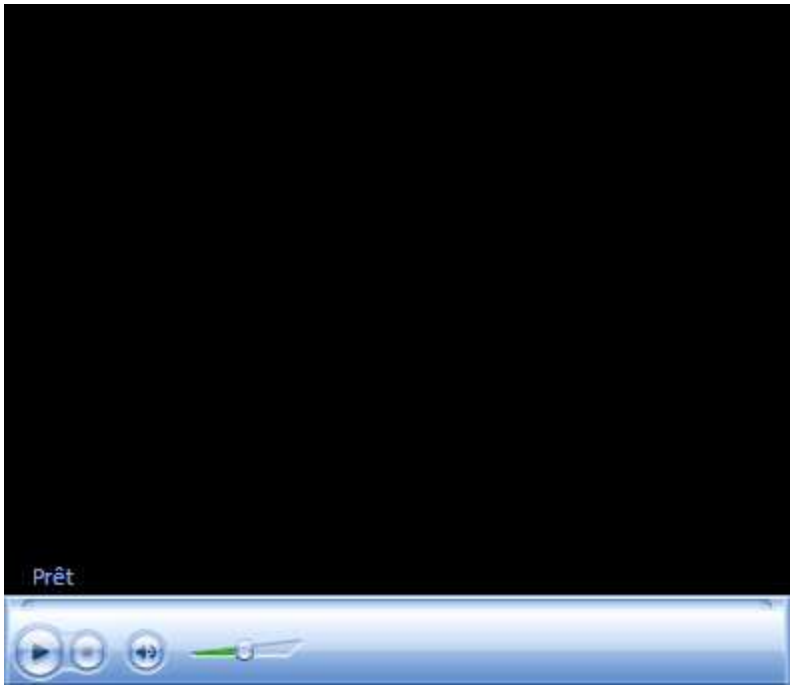
- Simulation of the asset: 3D representation of the terminal, including various mode of airflows.



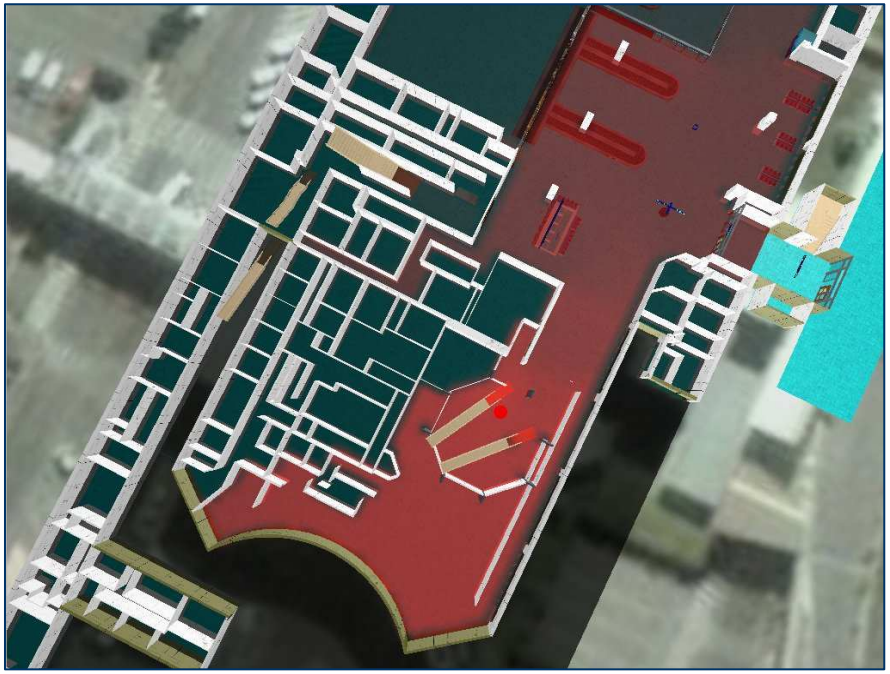

*courtesy from Thales*

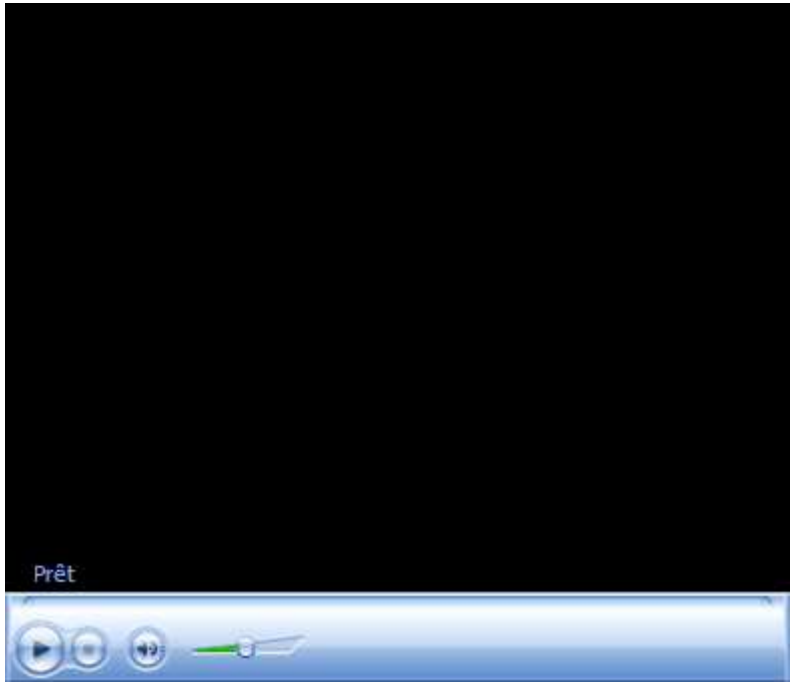
- Simulation of the mission of the assets: passengers can enter and exit the terminal, check in, wait for boarding, etc…




*courtesy from Thales*

- Simulation of the threat: dispersion and propagation of a CWA following the airflow mode, but also fire, intrusion.

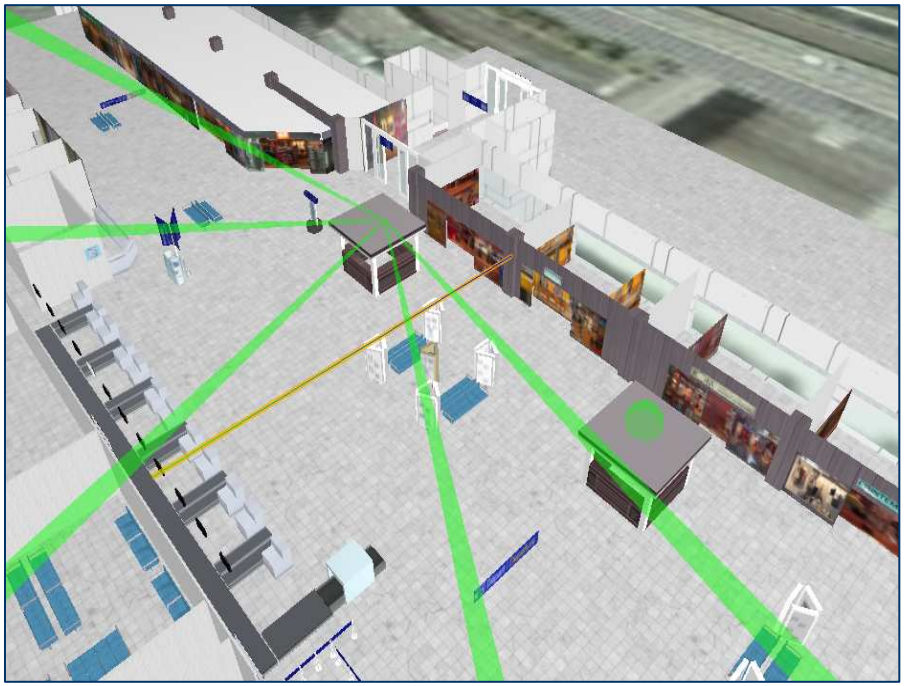


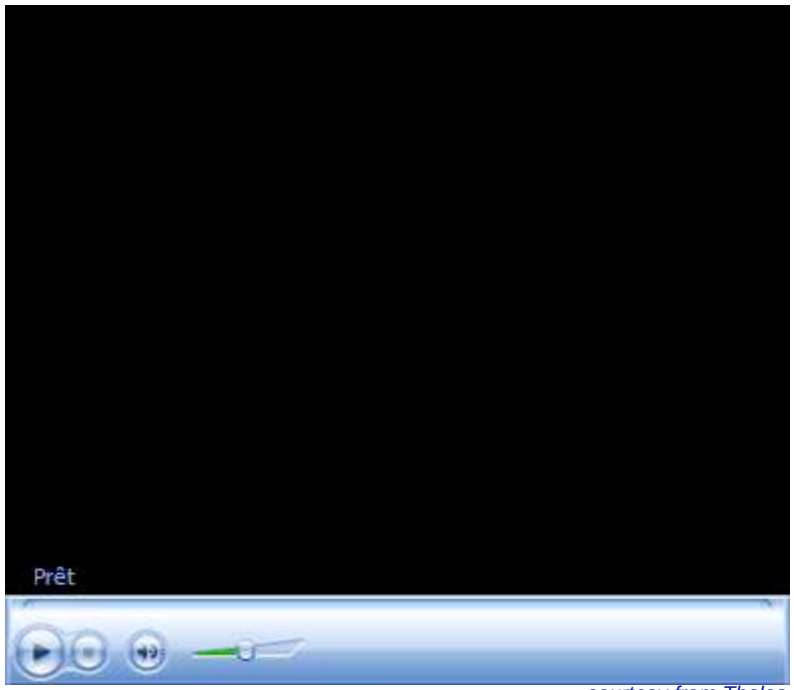



*courtesy from Thales*

- Simulation of the effect of the threat: passengers can feel and react to chemicals, collectively react to a crisis, panic…

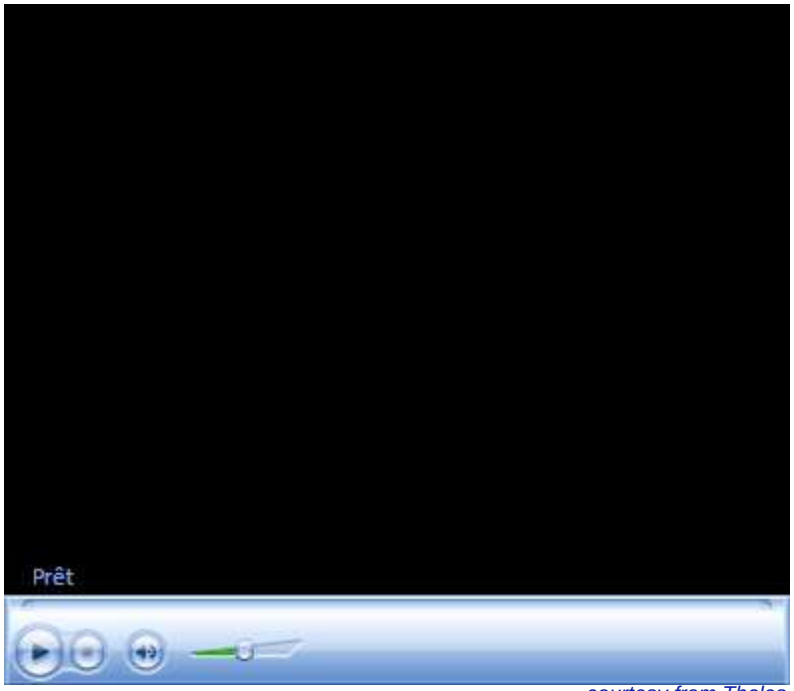
- Simulation of the detection part of the protection system: CCTV, point and stand-off detectors, with their characteristics (LoD, false alarm and false negative rates, response time…).





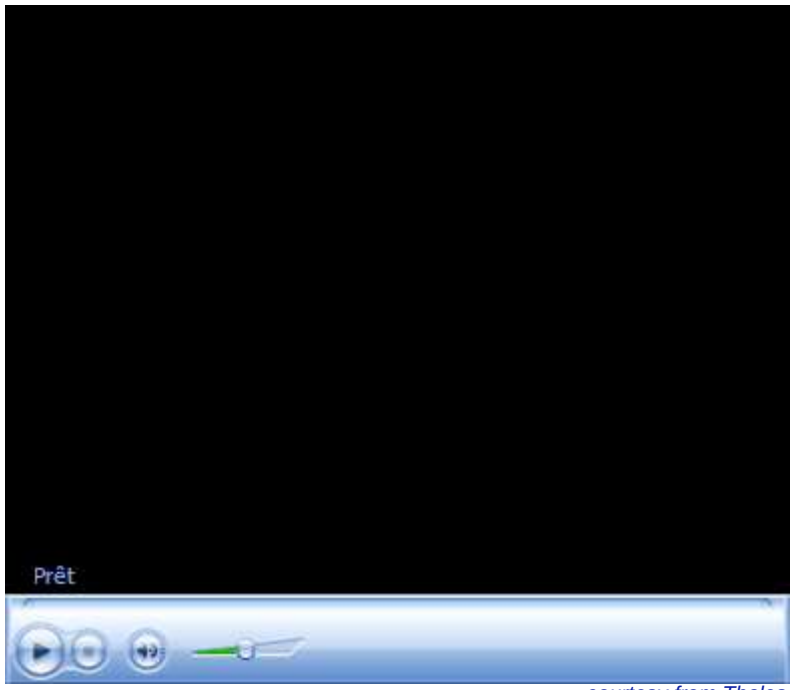

*courtesy from Thales*

- Simulation of the countermeasure part of the protection system: triggering of the emergency modes: airflow mode shift, emergency exits




*courtesy from Thales*

- simulation of a variety of aggression scenarios.
- simulation of various configurations of the protection system: types, characteristics and localization of the detectors, information management,
- analysis of the efficiency of the protection system, depending on the selected parameters.




*courtesy from Thales*

# TWOBIAS

- Full title: Two Stage Rapid Surveillance and Alarm System for Airborne Biological Pathogenic Agents.
- The aims are to:
  - simulate a bioterrorist attack on a critical asset (airport terminal, metro station, etc) and evaluate its consequences;
  - use simulation to design a protection system involving detection and countermeasures, optimize it, and evaluate its efficiency;
  - improve detectors accordingly;
  - develop the demonstrator, test it and compare the results with simulation predictions.

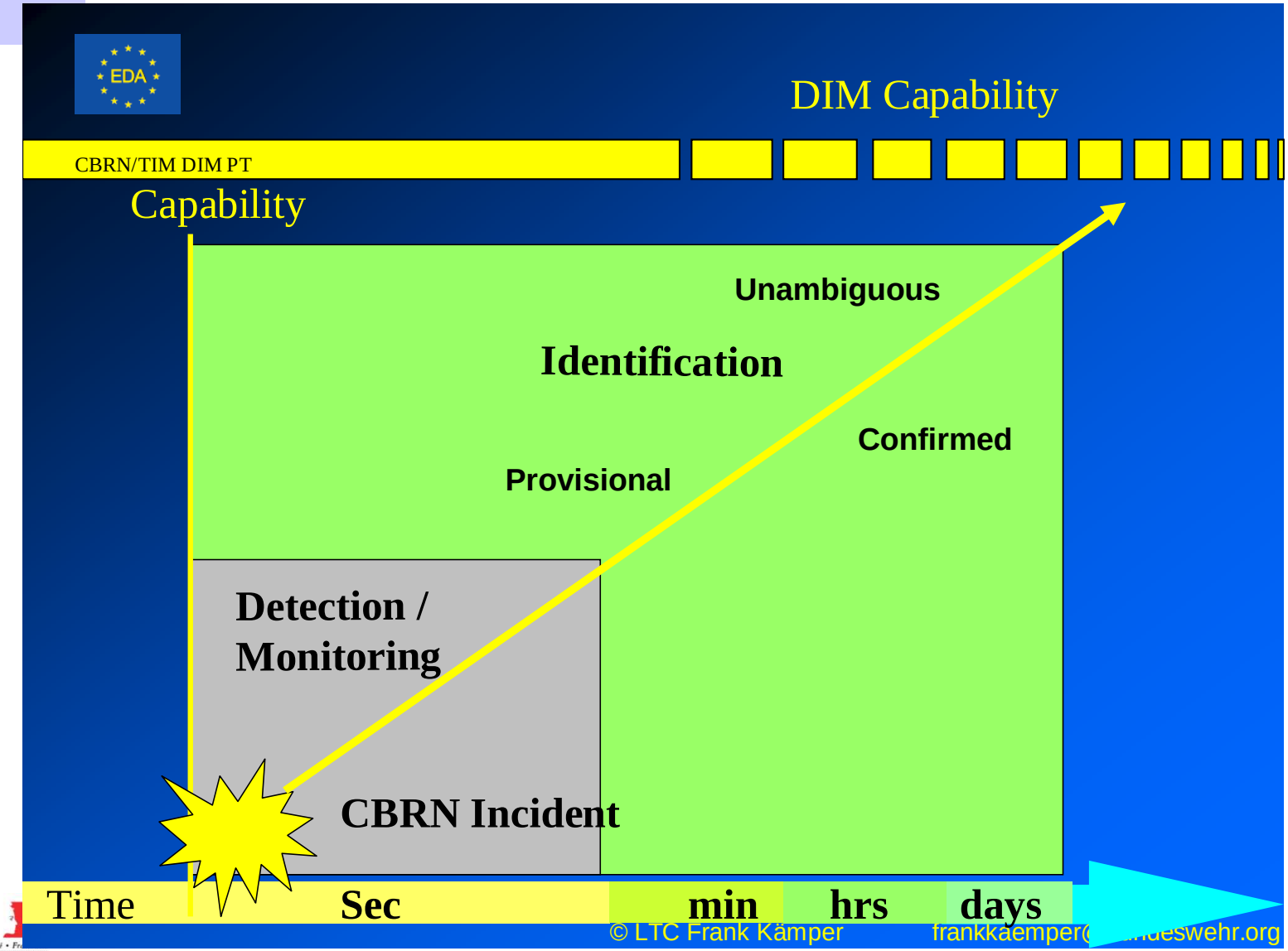
# TWOBIAS

- Expected features of the demonstrator:
  - May involve detectors with imperfect performances (eg: rate of false alarms);
  - Detectors and mitigation actions will be linked:
    - Detectors with high rate of false alarm will only trigger low regret actions (eg: HVAC mode shift).
    - Detectors with low rate of false alarm will be able to trigger high regret actions (eg: evacuation, call for first responders).
  - The detectors and identification equipment will be integrated within a system architecture.
    - command and control software will be developed
- Evaluation:
  - Detectors will be tested in aerosol test chambers.
  - Command and control software will be tested in a simulation environment.
  - The whole system will then be tested in as close as possible real-life conditions.
  - The results of this test will be compared to the simulation.

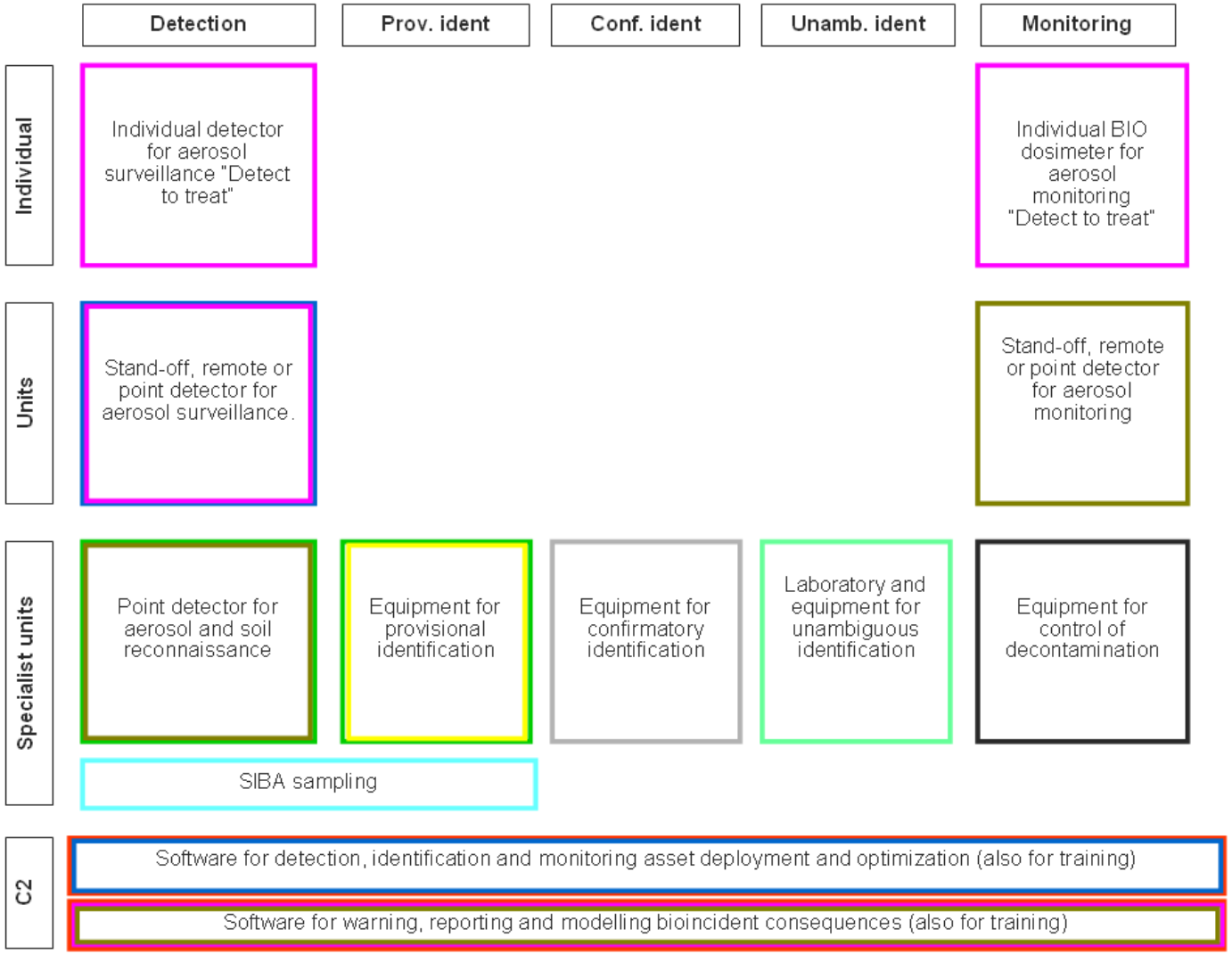
# BIOEDEP

- Stands for “Biological Equipment Development and Enhancement Project”.
- The aim is to:
  - specify the architecture of the future European Biological Integrated Reconnaissance Defense (BIRD) system.
  - specify the performance of the BIRD system
  - optimize the allocation of the BIRD system requirements to its sub-systems.
  - verify that specification and allocation will yield a system that will fulfill the need.
- Requirements due by end of 2010.
- Program phase could start in 2012, likely lead by OCCAR.

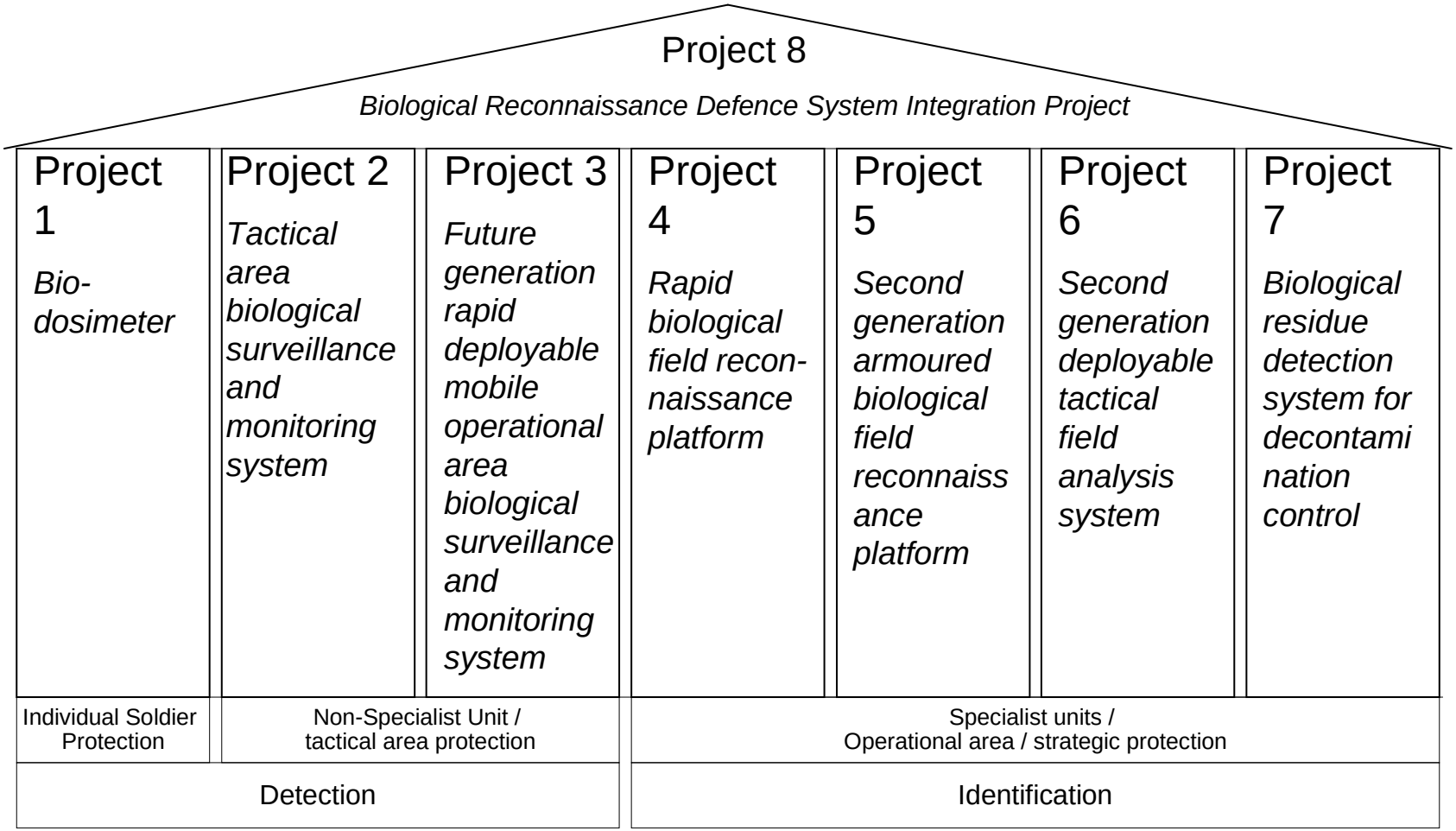
# BIOEDEP: CBRN DIM Concept



# BIOEDEP architecture



# BIOEDEP project organization



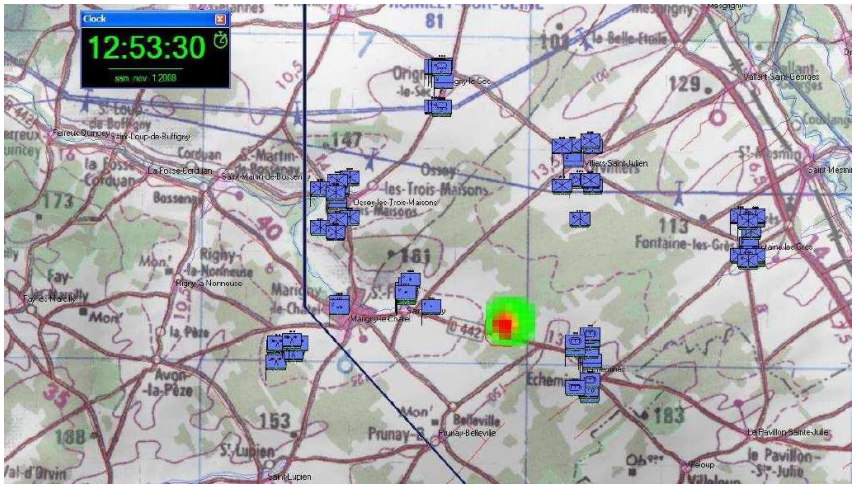
# BIOEDEP

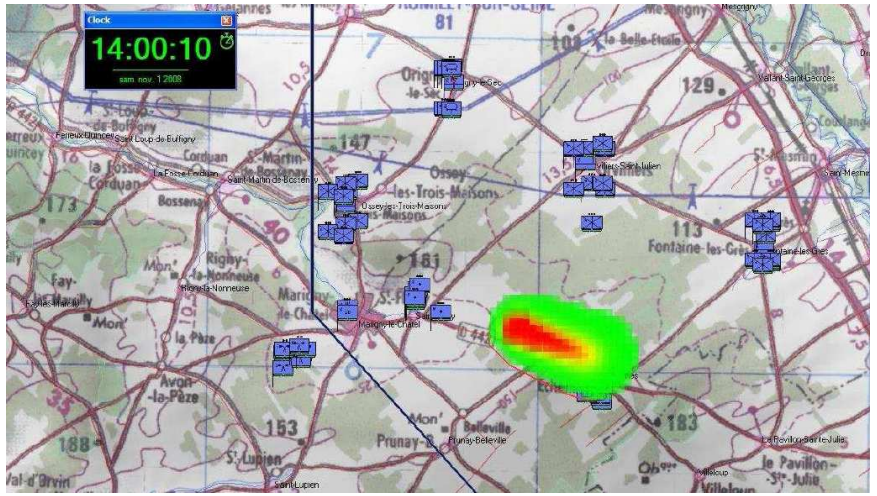
- During the project phase, simulation will be used to:
  - test possible physical architectures;
  - define the key system requirements;
  - propose allocation of these requirements to sub-systems and components (eg: limit of detection of detectors, rate of false alarm, rate of false negative, time response);
  - test overall performance of the system using various scenarios.

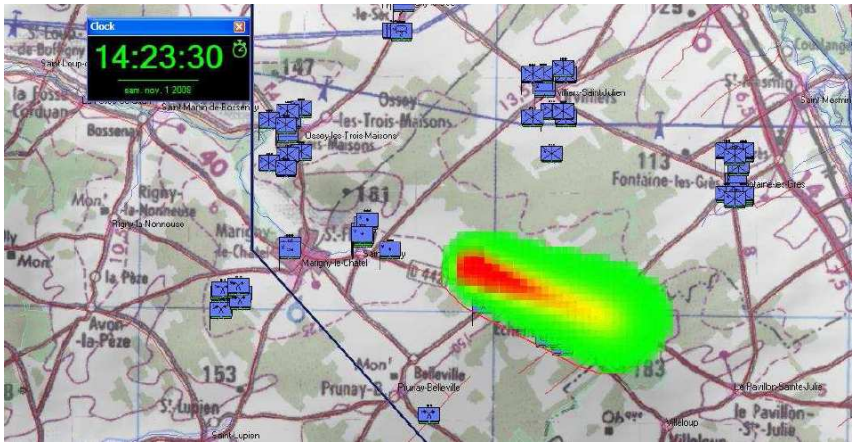
# BIOEDEP

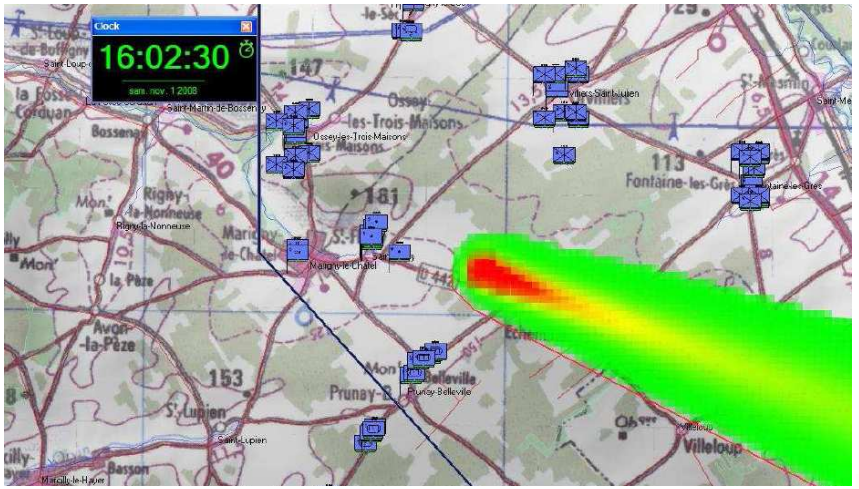
- Simulation will be applied to:
  - operational mission scenarios (wargame);
    - compliant with NATO and EU CBRN doctrine.
  - biological attack scenarios
    - initial dispersion, propagation depending on meteorological conditions and topography, effects on the forces;
  - BIRD system (all modules)
    - various architectures
    - several set of parameters for each architectures
  - Performance of the system will be measured:
    - time to complete the mission;
    - number of casualties

# BIOEDEP: example of CBRN wargame




*courtesy from Thales*

# Can we trust the models?

- Simulation platform is a federation of models including:
  - targeted asset: static and dynamic simulations, including human behavior simulations, doctrine;
  - environment: weather, terrain;
  - threat: source, propagation and effects;
  - protection system: detection and countermeasures.
- Evaluation of the models can be:
  - scientific: is the model compliant to physical laws?
  - statistic: does the model fit accurately with real-world observations?
  - operational: does the model fulfill the user's need (including ergonomics, ease of use)?

# Model VV&A

- Evaluation of a federation of models:
  - follows a standardized methodology (eg: DoD instruction 5000.61, MIL-STD-3022).
  - can be complex for some models:
    - atmospheric dispersion models: stochastic nature of the dispersion renders the scientific and statistical evaluations difficult.
    - with chaos, distribution of simulated data should be compared with distribution of observed data.
    - distributions of observed data are not always available. Under some hypotheses, they can be derived by a several approaches (eg: resampling methods such as bootstrap, or grouping of observations within regimes in ASTM Standard Guide D6589).

# Conclusion and proposal

- France approach to biothreat reduction relies on a series of plans (Vigipirate).
- Assessment of the efficiency of these plans can be partly addressed by simulation.
- Simulation platforms (models federations) have been or are currently being developed for that purpose.
- Models federation must be evaluated so as to ensure accuracy of the results.
- International collaboration is a good approach to benchmark and optimize these models.
- The European Commission will launch a call to foster this collaboration within Europe in a near future.

# Conclusion and proposal

- Collaboration may include any of the following:
  - Compare/design architecture of the simulation platforms;
  - Compare/design features of the simulation modules;
  - Organization of tabletop exercises to benchmark simulation platforms (eg: one common scenario and comparison of the simulation results).